

What is claimed is:

1. A reversibly expandable loop assembly comprising:

a plurality of links, each of said links having at least one center pivot joint and a plurality of end pivot joints, each of at least two of said plurality of end pivot joints proximate to the outer edge of said loop assembly and connected to another link;

each of said plurality of links being connected to another one of said plurality of links by at least two end pivot joints thereby forming a link pair,

said loop assembly comprising at least three link pairs, each of said at least three link pairs connected to at least two other link pairs through at least one of said end pivot joints;

each of said at least three link pairs connected to a central piece that is central to the loop assembly, said central piece being rotatable around a central axis, wherein the rotation of the central piece reversibly expands said loop assembly.

2. A loop assembly according to claim 1, wherein said connection between adjacent link-pairs are direct pivot connections between said internal corner pivot joints of said adjacent link-pairs.

3. A loop assembly according to claim 1, wherein said central piece comprises a scissor pair, wherein each half of said scissor pair is rotatably connected to each other.

4. A loop assembly according to claim 1, wherein the first link of said link pair having three pivots whose center points form an isosceles triangle, the second link of said link pair having two pivots whose distance is identical to the sides of that triangle, which links are joined by the pivot at the apex of the first link, the angle formed by drawing lines that lie on the center points of the three un-joined pivots is constant and unchanging for any relative angle between the first and second links;

5. A loop assembly according to claim 1, further comprising one or more hub elements for connecting said internal corner pivot joints of said adjacent link pairs thereto.

6. A structure reversibly expandable from a folded to an unfolded position with partially unfolded positions therebetween, comprising at least two loop assemblies in accordance with claim 1, interconnected by said perimeter corner pivot joints.

7. A structure according to claim 1, further comprising one or more link pairs having at least one perimeter pivot joint, connected by said perimeter pivot joint to said loop assembly.

8. A structure according to claim 4 having a three dimensional shape.

9. A structure according to claim 6, further comprising a plurality of loop assemblies connected together by the corner joints of said links of said loop assemblies, wherein at least one of said connection of said plurality of loop assemblies joins together three or more of said links, to form a reversibly expandable three-dimensional matrix of links.

10. A reversibly expandable three dimensional structure according to claim 6, wherein at least one of said loop assemblies in accordance with claim 1 comprise at least two link pairs lying in different planes and wherein the angle formed between any two planes of any two link pairs of said loop assembly is substantially constant in any position of said structure.

11. A loop assembly in accordance to claim 1, further comprising at least one sheet of material, said material comprising a plurality of stiff regions forming the links of the loop assembly and thin flexible regions forming corner pivot joints of said loop assembly and said stiff regions connected together by one or more of said thin flexible regions.

12. A loop assembly according to claim 9, further comprising two sheets of material, said two sheets of material joined together by a plurality of center pivot joint connections.

13. A loop assembly in accordance with claim 10, wherein said center pivot joints are living hinges.

14. A toy construction kit for building one or more reversibly expandable structures comprising a plurality of loop assemblies in accordance to claim 1, said loop assemblies including perimeter corner joints for connecting any two of said plurality of loop assemblies, whereby said plurality of loop assemblies may be assembled together in various combinations forming reversibly expandable structures of various shapes.

15. A toy construction kit for building one or more reversibly expandable structures comprising a plurality of links for assembly into link pairs, each of said links having a polygonal profile with three or more corners, a center joint and at least one corner pivot joint proximate to at least one of said corners for pivotally connecting two adjacent links, each of said link pairs capable of being connected to a central piece.

16. A toy construction kit according to claim 14, further comprising one or more hub elements, each of said hub elements to be shared by two or more of said links as a pivotal connection therebetween.

17. A toy construction kit according to claim 14, further comprising at least two links having at least three corner pivot joints.

18. A toy construction kit according to claim 14, further comprising at least one motor to mechanically rotate at least one central piece through a plurality of degrees clockwise and a plurality of degrees counter-clockwise.

19. A loop assembly according to claim 1, which further comprises an additional loop of connecting links, said connecting links each having an elongated profile, and each having one center joint and two terminal joints, wherein:

each terminal joint of each connecting link is pivotally connected to an adjacent connecting link, thereby forming a loop; and

each center joint of each connecting link is pivotally connected to a polygon link in the loop assembly.

20. A reversibly expandable loop assembly comprising:

a plurality of links having a polygonal profile with three or more corners, a center pivot joint and a plurality of corner pivot joints, each of at least two of said plurality of corner pivot joints proximate to at least two of said three or more corners, respectively, said plurality of corner pivot joints comprising at least one internal corner pivot joint and at least one perimeter corner pivot joint proximately located to the outer edge of said loop assembly;

each of said plurality of links connected to another one of said plurality of links at said center pivot joint thereby forming a link pair, said loop assembly comprising at least three link pairs; and

each of said at least three link pairs connected to at least two other link pairs, through at least one of said internal corner pivot joints.

21. A loop assembly according to claim 2, wherein each of said perimeter corner pivots has itself a pivotal connection to its corresponding polygon link pair, the axis of said pivotal connection lying essentially within the plane of said polygon link pair.

22. A loop assembly according to claim 20, wherein each perimeter corner pivot has one or more flexible regions such that said flexible region of said corner pivot shall flexibly deform when brought together with the flexible region of a corner pivot belonging to another loop assembly, said flexible regions then snapping back to an unstrained condition as the two corner pivots are brought into alignment, thus forming a pivotal attachment between said two perimeter corner pivots, thereby forming a hub element that acts essentially as a ball joint having three intersecting axes of rotation.

23. A toy construction kit for building reversibly expanding structures according to claim 12, comprising a plurality of loop assemblies according to claim 20.

24. A toy construction kit for building reversibly expandable structures according to claim 14, further including at least one scissor-pair, said scissor pair comprised of two links pivotally connected together at a center pivot joint, two ends of each of said two links each having a terminal pivot point that has itself a pivotal connection to its corresponding link, the axis of said pivotal connection lying essentially within the plane formed by said scissor pair.

25. A toy construction kit for building reversibly expandable structures according to claim 14, further including means to attach two loop assemblies together in a stacked arrangement.

26. A toy construction kit for building reversibly expandable structures according to claim 14, further including separate hub elements that may be attached to points on loop assemblies to provide extra attachment points.

27. A parallel four-bar linkage consisting of four links, each link being pivotally connected to two neighboring links, wherein

at least two of the links have at least three pivots each, two of said three pivots are pivotally connected to neighboring links, with one additional pivot that may be unconnected,

said three pivots of each link are located on the vertices of an isosceles triangle,

wherein two lines may be drawn, each line connecting the centerpoint of each of the additional pivots of the at least two links that have at least three pivots each, to that pivot which connects the two links that lie opposite the three-pivot links, and

said two lines form an angle which is constant and unchanging for any relative position of the linkage.

28. A parallel four-bar linkage consisting of four links, each link being joined to two neighboring links, where at least two connected links have at least four pivots each, and

the four pivots of each link are located on the vertices of two mirrored isosceles triangles, whereby the two quadrilaterals thus formed are similar in profile, but not necessarily of the same size,

two of those four pivots are connected to neighboring links which two pivots lie on the symmetry line of each quadrilateral, with two additional side pivots that may be unconnected,

whereby two lines may be drawn, each line connecting the centerpoints of two side pivots each belonging to a different four-pivot link, and

said two lines form an angle which is constant and unchanging for any relative position of the linkage.

29. A linkage according to Claim 28. where said two lines always intersect that pivot which connects the two links that lie opposite the four-pivot links.

30. A reversibly expandable loop assembly comprising:

a plurality of links having a polygonal profile with three or more corners, a center pivot joint and a plurality of corner pivot joints, each of at least two of said plurality of corner pivot joints proximate to at least two of said three or more corners, respectively, said plurality of corner pivot joints comprising at least one internal corner pivot joint and at least one perimeter corner pivot joint proximately located to the outer edge of said loop assembly;

each of said plurality of links connected to another one of said plurality of links at said center pivot joint thereby forming a link pair, said loop assembly comprising at least three link pairs:

each of said at least three link pairs connected to at least two link pairs, each of said at least three link pairs connected to a central piece central to the loop assembly, each of said two link pairs connected through at least one of said internal corner pivot joints of a link in each of said two link pairs, said perimeter corner pivot joint comprising a ball and socket arrangement.